

Abstract for 2013 AGU Fall Meeting

On the electrification of pyrocumulus clouds

Timothy J. Lang^{1*}, Steven A. Rutledge², Brenda Dolan², Paul Krehbiel³, William Rison³, Daniel T. Lindsey⁴

¹NASA Marshall Space Flight Center, (ZP11) Huntsville, AL 35812

²Colorado State University, Fort Collins, CO

³New Mexico Institute of Mining and Technology, Socorro, NM

⁴NOAA/NESDIS/STAR/RAMMB, Fort Collins, CO

*Presenting Author

The electrification (or lack thereof) of pyrocumulus clouds is examined for several different wildfires that occurred during 2012-2013. For example, pyrocumulus clouds above three Colorado wildfires (Hewlett Gulch, High Park, and Waldo Canyon; all occurred during summer 2012) electrified and produced small intracloud discharges whenever the smoke plumes grew to high altitudes (over 10 km above mean sea level, or MSL). This occurred during periods of rapid wildfire growth, as indicated by the shortwave infrared channel on a geostationary satellite, as well as by incident reports. In the Hewlett Gulch case, the fire growth led to increased updrafts within the plume, as inferred by multiple-Doppler radar syntheses, which led to the vertical development and subsequent electrification - a life cycle as short as 30 minutes. The lightning, detected by a three-dimensional lightning mapping network, was favored in high-altitude regions (~ 10 km MSL) containing modest reflectivities (25 dBZ and lower), ~ 0 dB differential reflectivity, and reduced correlation coefficient (~ 0.6 - 0.7). This indicated the likely presence of ice particles (crystals and aggregates, possibly rimed) mixed with ash. Though neither multiple-Doppler nor polarimetric observations were available during the electrification of the High Park and Waldo Canyon plumes, their NEXRAD observations showed reflectivity structures consistent with Hewlett Gulch. In addition, polarimetric and multiple-Doppler scanning of unelectrified High Park plumes indicated only irregularly shaped ash, and not ice, was present (i.e., reflectivities < 25 dBZ, differential reflectivity > 5 dB, correlation < 0.4), and there was no broaching of the 10 km altitude. Based on these results, the electrification likely was caused by ice-based processes that did not involve significant amounts of graupel. Results for pyrocumulus clouds above notable 2013 wildfires that also experienced rapid growth (e.g., Black Forest, Yarnell Hill, West Fork, Tres Lagunas, etc.) will be compared against the 2012 cases, with special emphasis on polarimetric NEXRAD and available lightning measurements, in order to better understand the physical processes responsible for pyrocumulus electrification.